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ABSTRACT

This report provides data on the geographical distribution patterns of federal research and development and other funds to colleges and universities, information on federal programs established in the 1960's to strengthen academic science, and factors accounting for progress by universities in competing for federal funds. Summarizing statements are followed by extensive data tables, graphs, and charts. Highlights of this report include the following: science funds provided in 1974 amounted to $2 billion for research and development and $651 million for plant and equipment, training, education, and other science activities; about $1.7 billion was provided for nonscience activities; geographical distribution of federal funds to colleges and universities has broadened in the past decade, both for science and nonscience funds; the top 100 institutions in 1964 received 85% of the total federal funds, whereas the top 100 institutions in 1974 received 66%. A fairly close correlation was found between the regional distribution of federal R&D funds and the geographical location of science manpower associated with the colleges and universities. (MH)

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REPORT OF THE COMPTROLLER GENERAL OF THE UNITED STATES

SE

Geographical Distribution Of Federal Science Funds To Colleges And Universities

This report provides data on the geographical distribution patterns of Federal research and development and other funds to colleges and universities, information on Federal programs established in the 1960s to strengthen academic science, and factors accounting for progress by universities in competing for Federal research and development funds. Some progress has been made in achieving a more balanced geographical distribution of Federal science funds, but the change has not been extensive.

PSAD-76-94 2 APRIL 16, 1976

SE 021 765

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-117219

The Honorable James B. Pearson
United States Senate

Dear Senator Pearson:

In accordance with your letter dated May 12, 1975, and subsequent discussions with your office, we analyzed data on the geographical distribution of Federal research and development funds to colleges and universities, examined information and data on some of the Federal programs established in the 1960s to strengthen academic science, and inquired into factors accounting for progress by some universities in competing for Federal research and development funds. Each of these matters is summarized below. Details are included in the three appendixes.

GEOGRAPHICAL DISTRIBUTION OF FEDERAL FUNDS TO COLLEGES AND UNIVERSITIES

The Federal Government provides considerable funds to colleges and universities for both science and nonscience activities. The latter includes a broad spectrum of funds for colleges, universities, and students which are not specifically related to science and engineering. Science funds provided in 1974 amounted to $2 billion for research and development and $651 million for research and development plant and equipment, training, education, and other science activities. About $1.7 billion was provided for nonscience activities.

Geographical distribution of Federal funds to colleges and universities has broadened in the past decade. This is true of total funds and science funds. Although the change in distribution patterns has not been extensive, it does show that flexibility exists in Federal funding of such institutions.

The top 100 institutions in 1964 received 85 percent of total Federal funds, whereas the top 100 institutions in 1974 received only 66 percent. This funding shift is primarily attributable to the large increase in Federal funding of nonscience activities. While only 6 percent of Federal funds to colleges and universities in 1964 was for

nonscience activities, it was nearly 40 percent in 1974. (See app. I, p. 8.) Institutions in geographical regions receiving smaller shares of Federal science funds tend to receive larger shares of the nonscience funds. Thus total Federal funds to colleges and universities are more evenly distributed geographically than are Federal science funds. (See app. I, p. 11.)

In 1965 the President expressed concern that Federal research and development funds were concentrated at a small number of colleges and universities. He directed Federal agencies to build up academic excellence in every part of the country. The top 20 institutions in 1964 received about 47 percent of Federal research and development funds. In 1974 the concentration had lessened somewhat, to about 40 percent. (See app. I, p. 19.) Institutions comprising the top 20 varied between 1964 and 1974. Our analysis shows that institutions comprising the top 20 research and development recipients in 1964 received only 38 percent of Federal research and development funds in 1974, a decline of 9 percent. (See app. I, p. 20.)

During the past decade three institutions have advanced into the top 20 recipients and 8 have advanced into the top 50 recipients. This shift of funds among institutions does not show up as a large change when analyzed by broad geographical regions because part of the shift is intraregional. (See app. I, p. 21.)

We found that there was a fairly close correlation between the regional distribution of Federal research and development funds and the geographical location of science manpower associated with the colleges and universities--enrollment of graduate science and engineering students, award of Ph. D. degrees, and employment of science and engineering Ph. D.s. (See app. I, pp. 13 and 14.)

FEDERAL SCIENCE DEVELOPMENT PROGRAMS

The memorandum submitted with your request identified the following Federal programs as being initiated in response to the concern expressed in the President's 1965 message.

--National Science Foundation's Science Development Program.

--National Science Foundation's College Science Improvement Program.

--Department of Health, Education, and Welfare's Strengthening Developing Institutions Program.

--Department of Defense's Project THEMIS.

Although it was intended to have an impact on the geographical distribution of science funds, the Science Development Program had the much broader objective of developing and improving institutions not considered outstanding in the sciences. Eligibility for this program was based on the potential for institutions and departments to make marked science improvements in a short period. Over 100 institutions received awards under this program.

The National Science Foundation terminated the program in 1972. The Foundation said that the program had substantially accomplished its objectives and that the Nation had enough Ph. D.-granting universities capable of high-quality science research and education to meet current and projected demands in all but a few specialized areas.

A June 1975 study by the National Board on Graduate Education found that the Science Development Program had contributed to improvements at funded institutions. The study also concluded that the program had achieved its objective of a wider dispersion of science funds. The study pointed out that the two goals, dispersing of funds on a geographical basis and developing of promising institutions into outstanding ones, are not exactly compatible. Many of the funded institutions were in geographical areas having universities already considered outstanding in science. (See app. II, pp. 24 to 27.)

The College Science Improvement Program was started in 1967 by the National Science Foundation to improve the science capabilities of predominantly undergraduate institutions. Undergraduate institutions are important to the Nation's strength in science education but have a small role as research and development performers, because research and development at colleges and universities tends to be the province of institutions granting doctoral degrees in science and engineering. Therefore, we believe this program could not have been expected to have much impact on building up research capability at the funded institutions.

The American Council on Education's 1971 study of the College Science Improvement Program found that students in the recipient schools were more likely to aspire to Ph. D. degrees and to plan on doing research as part of their future work. A 1972 National Science Foundation position paper concluded that the program's objectives had been met; however, the paper stated that the program was not intended

to be an equalizer of excellence and that dispersing funds on a geographic basis was not considered particularly desirable. Data in the position paper showed that institutions eligible for a major part of program funds were not evenly spread geographically. The Foundation terminated the program in 1973. (See app. II, pp. 28 to 30.)

The Strengthening Developing Institutions Program is considered by the Department of Health, Education, and Welfare to be a nonscience program. It is not directed at a balanced geographic dispersion of funds. Eligible institutions are those that are struggling for survival because of financial and other problems. Many of these institutions are in the South and have predominantly minority student enrollments. (See app. II, p. 30.)

Project THEMIS, initiated in 1967, provided research funds to 78 colleges and universities which were not heavily engaged in Department of Defense-sponsored research and development. These institutions were located in 41 States and the District of Columbia. One of the objectives of the program was to achieve a wider distribution of research funds. Over 80 percent of the recipient institutions ranked 50th or lower in Federal research and development support. Fiscal year 1969 was the final year for new THEMIS awards. THEMIS funding of ongoing projects ended in fiscal year 1971. THEMIS was terminated because of congressional concern that university development was more relevant to the mission of the National Science Foundation than to the Department of Defense. (See app. II, pp. 31 and 32.)

UNIVERSITIES MAKING CONSIDERABLE PROGRESS IN COMPETING FOR FEDERAL RESEARCH AND DEVELOPMENT FUNDS

During the 1964-74 period, many institutions made considerable progress in competing for Federal research and development funds. Twenty universities experienced more than 200 percent growth in Federal research and develoment funds received, and eighteen universities gained by 150 to 200 percent. During the same period, total Federal research and development funds awarded to universities increased by about 127 percent.

We visited four universities: the University of California at San Diego, the University of Alabama at Birmingham, Colorado State University, and Boston University. Each of these institutions experienced a greater than 200 percent increase in Federal research and development funds during the 1964-74 period. We met with administrators and researchers to discuss the factors accounting for the progress made by these universities. (See app. III, p. 33.)

Various factors cited as accounting for the universities' progress in competing for Federal research and development funds include

--recruiting outstanding researchers able to attract funds,

--commitment by the university administration to a strong research program,

--creating the proper academic environment to encourage research by the faculty,

--establishing endowed chairs to help recruit outstanding scientists,

--concentrating on national priority research areas,

--local community support, and

--Federal science development programs.

Development of science at the colleges and universities depends, in large measure, on commitments to that end by leaders at the individual institutions, their governing bodies, and State governments. The Federal Government is only one of several partners.

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We have not obtained agency comments on this report. Our work was limited primarily to analyzing published statistics and other data. The intention of your office to solicit comments from colleges and universities should provide insight into the issues relating to distributing of Federal research and development funds. You might consider exploring with the universities

--the "brain drain" effect where scientists migrate to universities recognized as already having outstanding research talent;

--the efforts made by universities to develop capability in research areas receiving increased Federal funding in recent years or areas likely to represent a national priority in the future;

--the factors which account for universities having more success in obtaining research funds from some Federal agencies than from others; e.g., Federal

agencies using outside peer review panels versus Federal agencies reviewing research proposals without outside peer review;

--the problem of supporting aspiring young faculty members who are not yet able to effectively compete with established scientists in a peer review award system;

--the need for another major Federal effort to build up science strength at universities in regions with few strong science centers of learning; and

--the initiatives by universities to emphasize the research aspect of their missions and to secure financial assistance in building research capability from the States and from other sources.

We shall be in touch with your office within the next few days to discuss the release of this report to agencies, congressional committees, and other interested parties. If we can be of further assistance, please advise us.

Sincerely yours,

Comptroller General
of the United States

GEOGRAPHICAL DISTRIBUTION OF FEDERAL FUNDS TO COLLEGES AND UNIVERSITIES

Federal funds (science and nonscience funds) to colleges and universities have increased from $1.6 billion in 1964 to $4.5 billion in 1974. In 1964 the top 100 institutions received 85 percent of the funds, whereas in 1974 they received only 66 percent, a considerable decrease in the concentration of total funds.

In 1964, $1.5 billion, or 94 percent, of the Federal funds to colleges and universitites was for science--research and development (R&D), R&D plant and equipment, training funds, etc. In 1974 Federal funds for science amounted to $2.7 billion, or 61 percent of the Federal funds to such institutions. The funding of science activities has not kept pace with the funding of nonscience activities. (See fig. 1.)

Over the same 10-year period, the proportion of Federal science funds for R&D versus other science activities (plant and equipment, training, education, etc.) has varied considerably. In 1964 about 63 percent of the science funds were for R&D. This decreased to 57 percent in 1967, reflecting, in part, added emphasis on institutional development programs during the mid-1960s. By 1974 R&D had increased to 76 percent of the Federal science funds.

There has also been a slight change in the type of research done by colleges and universities. Federal funding of basic or fundamental research at such institutions has decreased from about 79 percent in 1964 to about 76 percent in 1972. The National Science Foundation (NSF) estimate for 1974 was 70 percent basic research, 26 percent applied research and 4 percent development.

Another important overall factor in considering science funds provided to colleges and universitites is that, although the Federal Government provides most R&D funds expended by those institutions, the Federal Government does not provide most of the funds used for capital expenditures for R&D facilities and facilities for instruction in sciences and engineering. In 1973, for example, the Federal Government provided about 60 percent of the total funds expended by colleges and universities for scientific and engineering activities. Funds from State governments, industry, and other institutions are an important determinant of what and how science capabilities are developed. (See fig. 2.)

FEDERAL FUNDS FOR COLLEGES AND UNIVERSITIES/FISCAL YEARS 1964 – 1974

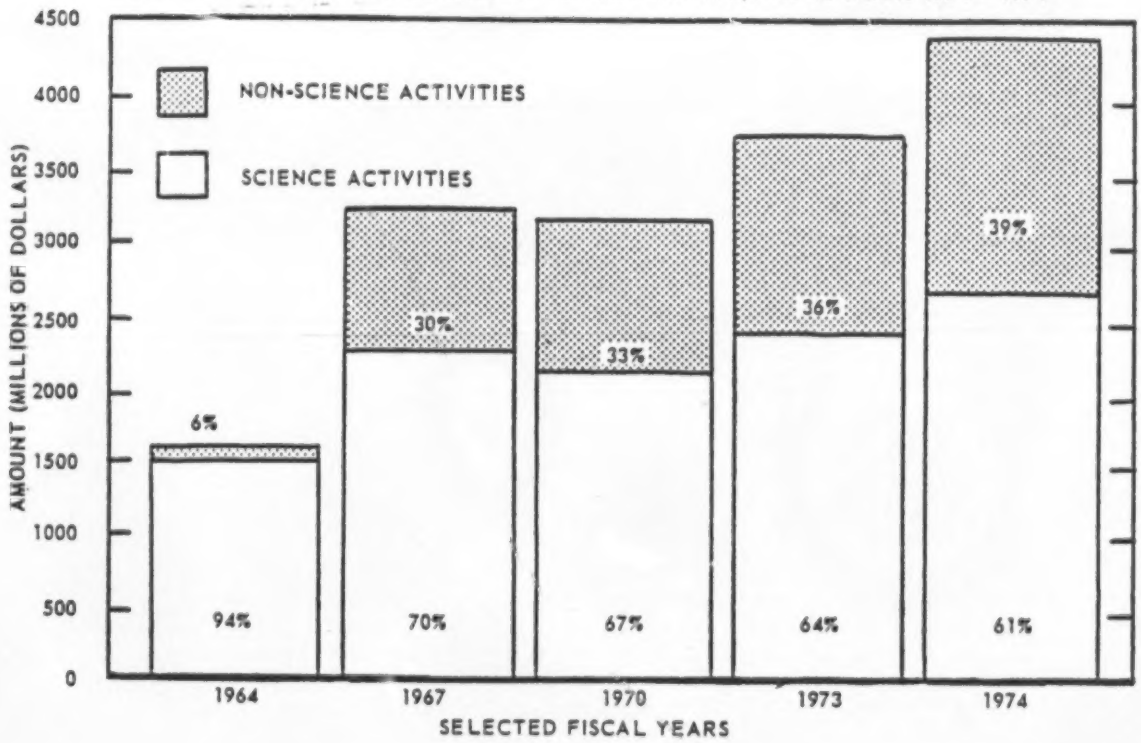
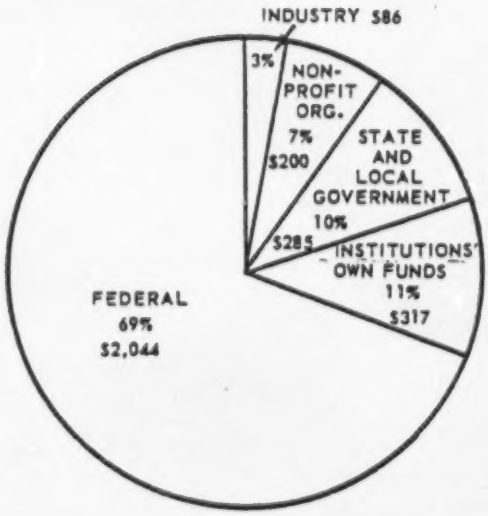
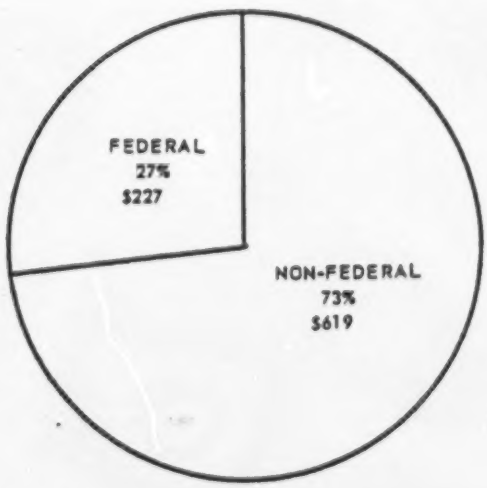


FIGURE 1

NONCAPITAL R&D EXPENDITURES (1973)



CAPITAL EXPENDITURES – R&D FACILITIES AND FACILITIES FOR INSTRUCTION IN SCIENCES AND ENGINEERING (1973)



MILLIONS OF DOLLARS

FIGURE 2

APPENDIX I

REGIONAL DISTRIBUTION OF FEDERAL FUNDS

The States in the nine regions traditionally used by the Government for statistical analyses are as follows:

Region:
New England:
- Maine
- New Hampshire
- Vermont
- Massachusetts
- Rhode Island
- Connecticut

Region:
Middle Atlantic:
- New York
- New Jersey
- Pennsylvania

South Atlantic:
- Delaware
- Maryland
- District of Columbia
- Virginia
- West Virginia
- North Carolina
- South Carolina
- Georgia
- Florida

East North Central:
- Ohio
- Indiana
- Illinois
- Michigan
- Wisconsin

West North Central:
- Minnesota
- Iowa
- Missouri
- North Dakota
- South Dakota
- Nebraska
- Kansas

East South Central:
- Kentucky
- Tennessee
- Alabama
- Mississippi

West South Central:
- Arkansas
- Louisiana
- Oklahoma
- Texas

Mountain:
- Montana
- Idaho
- Wyoming
- Colorado
- New Mexico
- Arizona
- Utah
- Nevada

Pacific:
- Washington
- Oregon
- California
- Alaska
- Hawaii

The following table shows the distribution of Federal science funds to colleges and universities in 1964 and 1974.

Distribution of Federal Science Funds to Colleges and Universities in 1964 and 1974

	R&D		R&D plant		Science training, education, and other activities		Total academic science	
	1964	1974	1964	1974	1964	1974	1964	1974
	(millions)							
Pacific	$159.5	$435.2	$ 22.4	$ 2.6	$ 57.2	$ 89.9	$239.1	$527.7
Middle Atlantic	188.4	368.0	15.9	2.0	78.0	95.0	282.3	465.0
East North Central	178.8	309.2	15.7	11.9	78.0	92.2	272.5	413.3
South Atlantic	105.6	259.3	15.6	1.1	63.2	105.1	184.4	365.5
New England	139.1	240.7	12.7	10.0	41.9	51.7	193.7	302.4
West North Central	56.4	134.8	4.4	0.1	45.2	56.4	106.0	191.3
West South Central	54.9	139.2	7.8	0.5	36.0	50.9	98.7	190.6
Mountain	41.5	116.2	5.6	0.4	22.5	30.3	69.6	146.9
East South Central	28.3	73.2	1.0	0.2	25.7	43.6	55.0	117.0
Territories outside the United States	3.6	9.5	0.3	0.2	4.4	6.7	8.3	16.4
Total	$956.1	$2,085.3	$101.4	$ 29.0	$452.1	$621.8	$1,509.6	$2,736.1

APPENDIX I

Institutions located in geographical regions receiving smaller shares of Federal science funds tend to receive larger shares of the Government's nonscience funds. This is important because of the large increase in Federal funding of nonscience activities since 1964.

Region	Percent of Federal funds in 1974		
	Science (note a)	Nonscience	Total (note a)
East South Central	4	9	6
Mountain	5	5	5
West North Central	7	10	8
West South Central	7	11	8
New England	11	6	9
South Atlantic	13	19	16
East North Central	15	15	15
Middle Atlantic	17	13	16
Pacific	19	12	16

[a]Percentages do not add to 100 because of rounding.

DISTRIBUTION OF FEDERAL SCIENCE FUNDS TO COLLEGES AND UNIVERSITIES

As shown below, our analysis of the geographical distribution of the Federal science funds by broad geographical regions since 1964 confirms the observation by Senator Pearson's office that little overall change has occurred in distribution patterns.

APPENDIX I

Region	1964	1974	Difference
		(percent)	
New England:			
R&D	15	12	-3
R&D plant	13	34	+21
Other science activities	9	8	-1
Total academic science	13	11	-2
Middle Atlantic:			
R&D	20	18	-2
R&D plant	16	7	-9
Other science activities	17	15	-2
Total academic science	19	17	-2
East North Central:			
R&D	19	15	-4
R&D plant	15	41	+26
Other science activities	17	15	-2
Total academic science	18	15	-3
West North Central:			
R&D	6	7	+1
R&D plant	4	1	-3
Other science activities	10	9	-1
Total academic science	7	7	0
South Atlantic:			
R&D	11	12	+1
R&D plant	15	4	-11
Other science activities	14	17	+3
Total academic science	12	13	+1
East South Central:			
R&D	3	4	+1
R&D plant	1	1	0
Other science activities	6	7	+1
Total academic science	4	4	0
West South Central:			
R&D	6	7	+1
R&D plant	8	2	-6
Other science activities	8	8	0
Total academic science	6	7	+1
Mountain:			
R&D	4	6	+2
R&D plant	6	1	-5
Other science activities	5	5	0
Total academic science	5	5	0
Pacific:			
R&D	17	21	+4
R&D plant	22	9	-13
Other science activities	13	14	+1
Total academic science	16	19	+3

As shown in the following table, the East South Central, Pacific, and the West South Central regions had the largest percentage per capita gains in science funds during the 1963-74 period. The East North Central, New England, and Middle Atlantic regions had the least growth. There has been little change in the ranking of regions during the 1963-74 period.

Region	Federal academic science funds per capita		Percent of increase
	1963	1974	
East South Central	$ 3.81	$ 8.74	129
Pacific	8.51	18.96	123
West South Central	4.51	9.26	105
South Atlantic	5.46	11.01	102
Mountain	7.76	15.61	101
West North Central	6.26	11.47	83
Middle Atlantic	7.25	12.47	72
New England	14.76	24.89	69
East North Central	6.72	10.11	50

DISTRIBUTION OF FEDERAL R&D FUNDS TO COLLEGES AND UNIVERSITIES

In 1974, 85 percent of the Federal R&D funds to colleges and universities went to the top 100 institutions. The remaining 15 percent was distributed to 478 institutions.

We found that measures of science manpower resources--such as science and engineering Ph. D.s employed in colleges and universities, graduate science and engineering students, and Ph. D. degrees awarded--generally followed the proportion of R&D funds by geographical regions.

APPENDIX I

Distribution of Federal R&D Funds Compared to Science Manpower Resources by Geographical Regions

Region	R&D funds (1974) (note b)	Science and engineering (note a) Graduate students (fall 1973)	Ph. D.s awarded (1970-71)	Ph. D.s employed in educational institutions (January 1974)
	(Percent)			
Pacific	20.8	14	16	13
Middle Atlantic	17.7	20	17	18
East North Central	14.8	19	22	18
South Atlantic	12.4	12	11	15
New England	11.5	8	9	9
West South Central	6.7	8	7	8
West North Central	6.5	8	9	9
Mountain	5.6	6	6	6
East South Central	3.5	3	3	5

[a] Science manpower percentages do not add to 100 because of rounding.

[b] Territories outside the United States equal small fraction of total.

APPENDIX I

Because research by colleges and universities is essentially the province of those institutions awarding doctoral degrees in sciences and engineering, we believe that Federal R&D funds will be channeled largely into those institutions. The top 100 institutions receiving Federal R&D funds traditionally account for about 80 percent of doctoral degrees awarded in sciences and engineering and about 85 percent of the Federal R&D funds. The location of the institutions capable of research is a definite constraint on any Federal effort to more broadly distribute its R&D funds.

By broad geographical regions, the number of institutions in the top 100 are as follows:

Region	Number of universities in 1974
Middle Atlantic	17
South Atlantic	17
Pacific	16
East North Central	14
New England	11
Mountain	7
West North Central	7
West South Central	7
East South Central	4
Total	100

Figure 3 shows the geographical location of the top 100 colleges and universities in Federal R&D funds.

LOCATION OF THE TOP 100 UNIVERSITIES AND COLLEGES IN FEDERAL R&D FUNDS RECEIVED IN 1974 (85 PERCENT OF R&D FUNDS)

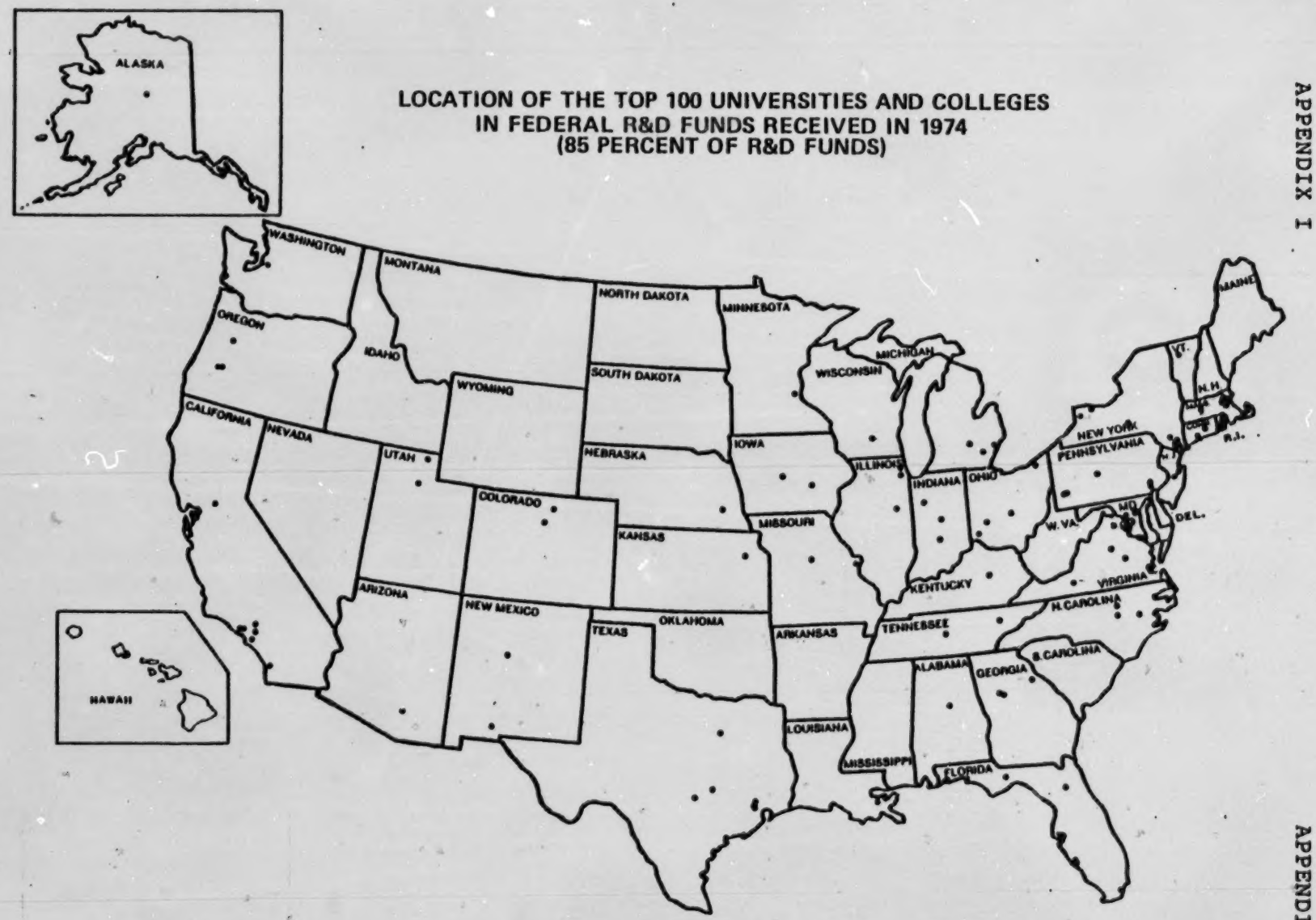


FIGURE 3

A per capita analysis shows that the West South Central and East South Central regions had the largest percentage increases in Federal R&D funds received during the 1963-74 period. The New England, East North Central, and Middle Atlantic regions experienced the least growth in percentage per capita Federal R&D funds.

Region	Federal R&D funds per capita 1963	1974	Percent of increase
West South Central	$2.38	$6.76	184
East South Central	1.93	5.47	183
Mountain	4.46	12.35	177
Pacific	5.65	15.64	177
West North Central	3.20	8.08	153
South Atlantic	3.15	7.81	148
Middle Atlantic	4.81	9.87	105
East North Central	4.23	7.57	79
New England	11.72	19.81	69

Principal agencies providing R&D funds

Federal R&D funds to colleges and universities amounted to $2.1 billion in 1974. The principal Federal agencies providing these funds were the Department of Health, Education, and Welfare (HEW), NSF, Department of Defense (DOD), Department of Agriculture, and Atomic Energy Commission. These five agencies provided $1.9 billion or 90 percent of the funds. The two Federal agencies providing the most R&D funds were HEW and NSF which contributed $1.5 billion, or 72 percent, of the funds.

Institutions in regions receiving the most funds from these five agencies were in the Pacific, Middle Atlantic, East North Central, and South Atlantic regions. The least funded regions are East South Central, Mountain, West North Central, and West South Central.

Regional Distribution of Federal R&D Funds by Principal Sponsor in 1974

Region	HEW	NSF	DOD	Dept. of Agriculture	Atomic Energy Commission	Total
	(percent)					
Pacific	19.2	26.7	26.1	8.6	20.4	20.9
Middle Atlantic	20.5	18.3	11.4	6.7	18.3	18.4
East North Central	14.0	16.5	15.5	11.7	19.8	14.9
South Atlantic	13.6	8.8	9.9	18.9	9.6	12.3
New England	10.1	14.5	14.7	4.9	15.7	11.4
West South Central	6.9	4.2	8.3	10.9	4.0	6.6
West North Central	7.9	3.8	2.1	13.2	2.8	6.5
Mountain	3.7	6.1	5.9	9.1	4.0	5.1
East South Central	3.9	1.2	2.0	13.4	1.7	3.6
Territories outside the United States	.2	.1	-	2.7	3.6	.4

Note: Percentages do not add to 100 because of rounding.

CONCENTRATION OF FEDERAL R&D FUNDS IN SMALL NUMBER OF COLLEGES AND UNIVERSITIES

A 1965 Presidential message observed that Federal R&D funds were concentrated in too few institutions in too few areas of the country. Since 1964 the concentration of funds has lessened somewhat, as shown in the following table.

APPENDIX I

	1964	1967	1970	1974	Change (1964-74)
	(percent)				
Top 20 institutions:					
Percent of R&D total	47	45	43	40	-7
Percent of academic science total	43	37	38	38	-5
Top 50 institutions:					
Percent of R&D total	71	69	67	66	-5
Percent of academic science total	67	61	62	63	-4
Top 100 institutions:					
Percent of R&D total	89	88	84	85	-4
Percent of academic science total	87	80	81	83	-4

Institutions making up the top 20, 50 and 100 in 1964 and 1974 have changed, reflecting flexibility in the fund distribution pattern. For example, the chart on page 8 shows that the proportion of Federal R&D funds going to institutions in the top 20 in 1964 has declined by 9 percent. Over one-fourth of this decline is attributable to the formal separation of the Draper Laboratory from the Massachusetts Institute of Technology in July 1973. Draper Laboratory, now an independent research organization, received $85.6 million in Federal R&D funds in 1974.

APPENDIX I

R&D Funds Received by the Top 20 in 1964 Compared to 1974 R&D Amounts for the Same Institutions

Institution and region	1964 amount (000 omitted)	1974 amount (000 omitted)	Percent of total R&D 1964	Percent of total R&D 1974	Percent difference
Massachusetts Institute of Technology (New England)	$ 63,206	$ 61,074	6.61	2.93	-3.68
University of Michigan (East North Central)	33,907	39,931	3.55	1.91	-1.64
Columbia University (Middle Atlantic)	30,188	46,054	3.16	2.21	-0.95
Stanford University (Pacific)	27,645	53,565	2.89	2.57	-0.32
Harvard University (New England)	26,676	48,486	2.79	2.32	-0.47
University of California at Los Angeles (Pacific)	24,640	53,402	2.58	2.56	-0.02
University of Chicago (East North Central)	24,076	33,217	2.52	1.59	-0.93
University of Illinois at Urbana (East North Central)	22,964	32,700	2.40	1.57	-0.83
University of California at Berkeley (Pacific)	22,792	44,090	2.38	2.11	-0.27
University of Wisconsin at Madison (East North Central)	18,181	51,095	1.90	2.45	+0.55
University of Pennsylvania (Middle Atlantic)	17,942	36,712	1.88	1.76	-0.12
Johns Hopkins University (South Atlantic)	17,877	39,569	1.87	1.90	+0.03
New York University (Middle Atlantic)	17,740	27,719	1.85	1.33	-0.52
University of Washington (Pacific)	16,506	56,909	1.73	2.73	+1.00
Cornell University (Middle Atlantic)	16,359	33,810	1.71	1.62	-0.09
University of Minnesota at Minneapolis, St. Paul (West North Central)	15,611	36,471	1.63	1.75	+0.12
University of Texas at Austin (West South Central) (note a)	15,482	21,169	1.62	1.02	-0.60
Yale University (New England)	14,117	37,671	1.48	1.81	+0.33
Ohio State University (East North Central) (note a)	12,908	19,642	1.35	0.94	-0.41
Princeton University (Middle Atlantic) (note a)	11,573	13,334	1.21	0.64	-0.57
Total	$ 450,390	$ 786,620	47.11	37.72	-9.39

[a]Not in top 20 in 1974.

Three institutions have advanced into the top 20, and 8 institutions have advanced into the top 50 since 1964. Notable examples of these include:

Institution and region	Ranking 1964	Ranking 1974
University of California, San Diego (Pacific)	37	5
Washington University (West North Central)	28	18
University of California, San Francisco (Pacific)	36	19
University of Alabama, Birmingham (East South Central)	80	40
University of Hawaii (Pacific)	71	41
City University of New York--Mt. Sinai School of Medicine (Middle Atlantic)	(a)	44
Colorado State University (Mountain)	68	45
Boston University (New England)	83	50

[a]Not in top 100 in 1964.

The advancing and losing institutions are geographically widespread. The shifts did not translate into changes in the broad geographical distribution patterns.

GEOGRAPHIC IMPLICATION OF SUCCESS IN COMPETITION OF FEDERAL SCIENCE FUNDS

During the July 1975 hearings before the Subcommittee on Science, Research, and Technology, House Committee on Science and Technology, NSF presented data showing award success rates (applications for awards compared to awards received) for 1974 by geographical area. Although this data includes all performers, the largest class of performers by award amount and number of awards was colleges and universities.

Ranking the States by average success rates for performers located within each State shows that the

--average success rates of the top 10 States ranged from 52 to 60 percent,

--average success rates of the lowest 10 States ranged from 30 to 38 percent,

--top 10 States accounted for 29 percent of the proposals and 40 percent of the NSF award amounts, and

--bottom 10 States accounted for 7 percent of the proposals and 3 percent of the NSF award amounts.

Eight of the 10 least successful States were located in the East South Central (3), West South Central (2), and the West North Central (3) regions. Seven of the 10 most successful States were located in the Pacific (4) and New England (3) regions.

APPENDIX I

AWARDS BY NSF IN 1974

	Award success ratio (percent)	NSF award amount (millions)
States with highest success ratio and region:		
Washington, D.C. (South Atlantic) (note a)	60	$ 20.0
California (Pacific)	58	94.6
Hawaii (Pacific)	58	4.0
Alaska (Pacific)	57	3.1
Massachusetts (New England)	57	55.5
Rhode Island (New England)	56	6.6
New Jersey (Middle Atlantic)	56	11.8
Oregon (Pacific)	55	7.7
Connecticut (New England)	54	8.0
Arizona (Mountin)	52	15.7
Total		$227.0
States with lowest success ratio and region:		
South Carolina (South Atlantic)	30	$ 1.3
Arkansas (West South Central)	34	.6
Alabama (East South Central)	34	2.3
South Dakota (West North Central)	35	.5
New Mexico (Mountain)	36	1.8
Oklahoma (West South Central)	36	2.7
Nebraska (West North Central)	37	1.6
Kansas (West North Central)	37	2.2
Kentucky (East South Central)	38	1.3
Mississippi (East South Central)	38	2.1
Total		$16.4

[a]High-success ratio ranking is primarily due to the high-success rates of many nonprofit organizations, such as the National Academy of Sciences and the American Chemical Society.

PROGRAMS TO STRENGTHEN COLLEGES AND UNIVERSITIES

The staff memorandum attached to Senator Pearson's May 1975 request referred to several Federal programs initiated as a result of the President's message of September 13, 1965. These included the Science Development Program (SDP), College Science Improvement Program (COSIP), Strengthening Developing Institutions Program (SDIP), and Project THEMIS.

SCIENCE DEVELOPMENT PROGRAM

In 1965 NSF started SDP, an experiment in institutional funding. SDP resulted from (1) a perceived need to increase the number of high-quality graduate science education programs, (2) criticism by Congressmen and educators concerning the traditional pattern of Federal science assistance to colleges and universities, and (3) the emergence of political pressure on the Federal Government and on NSF to distribute Federal science money along broader geographical lines.

SDP objectives were to increase the number of outstanding universities in science research and education and to build up promising science institutions in regions and States that did not have outstanding universities.

The program was aimed at "second tier" institutions; i.e., those not considered outstanding. Schools already considered outstanding in the sciences were deliberately excluded from SDP. Only institutions with graduate programs in science were eligible for SDP grants.

SDP consisted of three subprograms--University Science Development (USD), Special Science Development (SSD), and Departmental Science Development.

USD involved awards of 3-year grants. Many institutions received 2-year supplementary grants. NSF accepted over 100 grant applications and awarded about $177 million to 31 institutions during the 1965-72 period. Most individual grants ranged between $3 million and $7 million. USD permitted institutions to conduct many activities under one grant, such as appointment of new and visiting professors, faculty development, construction of new facilities, improvement of existing facilities, purchase of new equipment, support of graduate students, and support of research.

The purpose of SSD was to fund institutions applying for a USD grant but judged by NSF to be lacking in sufficient overall science strength to justify a total institutional award. Instead, SSD grants totaling $11.9 million were awarded to 1 or 2 science departments at each of 11 institutions during the period 1966-70.

Departmental Science Development was started in January 1967 as an alternative to USD. It funded departments to encourage the development of interdisciplinary studies. NSF awarded grants amounting to $41 million to departments in 62 institutions during the period 1967-71.

NSF said that it terminated SDP in 1972 because the program had substantially accomplished its objectives and the Nation had a sufficient number of Ph. D.-granting universities capable of high-quality science research and education to meet current and projected demands in all but a few specialized areas.

In June 1975 the National Board on Graduate Education published its study evaluating SDP. The study provided insight into the quality of graduate education at the funded institutions and the geographic distribution of funds. It considered several indicators of quality--faculty size, faculty mobility, faculty publication rates, graduate student enrollments and quality, Ph. D. production, and post doctorate employment.

The study concluded that:

--SDP funds had a positive effect on the research capacity of the funded institutions.

--The quality of first-year students improved in the funded departments, but receipt of a grant was not closely related to increases in graduate enrollments.

--Recipients realized some gains in doctorate production, but the gains were not extensive.

--The goal of geographic dispersion of the funds was largely achieved, resulting in a wider distribution of science personnel and resources in the United States.

The study also pointed out that the two goals, dispersing funds on a geographical basis and developing promising

institutions into outstanding universities, are not exactly compatible. Many of the funded institutions were in geographical areas having universities already considered outstanding in science.

The following table comparing the geographical distribution of SDP funds (1965-72) with the distribution of Federal science funds in 1964, the year before SDP began, confirms that many of the institutions funded under SDP were in geographical areas having universities already considered outstanding in science.

Geographic Distribution of SDP Funds (1965-72)

Region	Leading universities (note a)	SDP institutions	SDP amount (millions)	SDP amount (percent)	Total academic science funds in 1964 (percent)	Di
New England	3	7	$ 6.3	2.8	13	
Middle Atlantic	3	19	41.5	18.3	19	
East North Central	4	16	40.4	17.8	18	
West North Central	1	5	8.6	3.8	7	
South Atlantic	0	16	46.0	20.2	12	
East South Central	0	6	9.0	4.0	4	
West South Central	0	10	23.1	10.2	6	
Mountain	0	12	19.3	8.5	5	
Pacific	4	12	32.8	14.4	16	
Total	15	103	$227.0	100.0	100	

[a]Institutions considered "centers of excellence" according to the Cartter r
based on a 1964 survey by Allan M. Cartter, "An Assessment of Quality in
Education."

COLLEGE SCIENCE IMPROVEMENT PROGRAM

In January 1967 NSF initiated the College Science Improvement Program which was directed to the needs of that segment of undergraduate colleges producing half of the Nation's science baccalaureates. These colleges had been relatively unsuccessful in obtaining Federal funds for their science programs. According to NSF, COSIP goals were:

> "to accelerate the development of the science capabilities of predominantly undergraduate institutions and to enhance their capacity for continuing self-renewal."

COSIP was aimed at benefiting professors and students, subject matter and methods of instruction, curricula and individual courses, facilities, and teaching materials.

In fiscal year 1969 the original COSIP became COSIP A, and COSIP B was added. COSIP B had the same purpose as the original COSIP, differing only in that it was for projects best accomplished by a group of cooperating institutions.

COSIP C, which also started in fiscal year 1969, involved regional groups of 2-year colleges. Each group entered into a cooperative arrangement with a nearby major institution to accelerate faculty development and related course content improvements in a given science.

A fourth part of the program, COSIP D, began in fiscal year 1972 and was intended for those 4-year colleges historically providing educational opportunities to disadvantaged ethnic minorities. These institutions were considered disadvantaged in receiving funds for their science education programs.

The table below shows the allocation of COSIP funds to the subprograms.

Segment	Fiscal years	Participating institutions	Amounts of awards (millions)
A	1967-73	160	$31.0
B	1969-72	199	2.6
C	1969-72	662	5.1
D	1972-75	85	24.3
Total			$63.0

According to a 1972 NSF position paper, COSIP was not intended to be an equalizer of excellence, nor was geographic distribution of funds accepted as particularly desirable. Data in this paper showed, for example, that institutions eligible for COSIP A were not evenly distributed geographically; there were none in Hawaii and Wyoming, only 8 in Kansas, but 62 in Pennsylvania and 57 in New York. Because eligible institutions were not evenly distributed geographically, award recipients were not likely to reflect an even geographical distribution. Eighty-seven percent of COSIP D funds went to three regions--South Atlantic, East South Central and West South Central.

The table below presents the regional distribution of COSIP funds for 1967-75.

Region	COSIP segments A	B	C	D	COSIP total
	(percent)				
New England	9.6	11.7	0.4	-	5.2
Middle Atlantic	14.7	9.2	10.2	2.2	9.3
East North Central	20.5	16.7	11.8	2.9	12.9
West North Central	14.3	4.9	18.5	2.4	9.7
South Atlantic	17.1	9.7	14.0	43.0	26.5
East South Central	7.7	24.5	13.5	27.7	16.6
West South Central	7.8	9.1	11.2	15.9	11.2
Mountain	2.0	-	9.0	1.4	2.2
Pacific	6.3	14.2	11.4	0.7	4.9
Territories outside the United States	-	-	-	3.8	1.5
Total	100.0	100.0	100.0	100.0	100.0

In 1971 the American Council on Education published a study of COSIP A and B which revealed several beneficial effects on grant recipients, including the following:

--Students in COSIP-recipient schools were significantly more likely to aspire toward the Ph. D. degree and to plan on doing research as a part of their future work.

--Students were less likely to transfer out of schools which received COSIP grants.

--There was a slight positive correlation between the presence of COSIP support at the institution and the students' plans to teach as a career.

A 1974 survey of 163 COSIP A and B project directors at the colleges also showed important changes in science education at COSIP institutions while using the grants. These changes affected students, faculty, science departments, and the institution in a broader sense.

The 1972 NSF position paper concluded that COSIP objectives had been met. The paper recommended the termination of COSIP, with the creation of a related experimental program called Restructuring the Undergraduate Learning Environment. This program was initiated in fiscal year 1974 to encourage the development of major alternative institutional approaches to the style, organization, and content of undergraduate science.

The last COSIP awards were made in fiscal year 1973. COSIP D was renamed the Minority Institutions Science Improvement Program and broadened to include 2-year colleges. NSF is continuing this program during fiscal year 1976.

STRENGTHENING DEVELOPING INSTITUTIONS PROGRAM

The Strengthening Developing Institutions Program is administered by HEW's Office of Education. SDIP is not aimed at a balanced geographical dispersion of funds. HEW considers SDIP a nonscience activity.

SDIP attempts to strengthen those institutions of higher education which are struggling for survival and are isolated from the main currents of academic life.

SDIP's purpose is to strengthen developing colleges through funding programs in faculty growth, curriculum improvement, administrative development, and student services. These developing institutions are limited in their ability to attract students, to engage outstanding faculty members, to offer diverse curricula, and to acquire adequate financial resources. Grants are made to institutions to help them overcome these handicaps and develop basic strengths needed to attain secure status and national visibility. Appropriations for SDIP during fiscal years 1966-76 amounted to over $600 million.

PROJECT THEMIS

In 1967 DOD initiated a program called Project THEMIS to fund research in defense-related fields at institutions of higher education not heavily engaged in DOD-sponsored R&D. DOD did not consider THEMIS to be an institutional development program; however, the program's objectives were similar to SDP's. The program was intended to (1) meet part of DOD's long-term research needs, (2) strengthen more of the Nation's universities, (3) increase the number of institutions performing high-quality research, (4) achieve a wider geographical distribution of research funds, and (5) enhance the Nation's academic capability in science and technology. Project THEMIS included 118 awards to 78 institutions (in 41 States and the District of Columbia) amounting to $88 million.

Project THEMIS awards ended in fiscal year 1969, and funding of ongoing projects ended in fiscal year 1971. The program was terminated because of congressional concern that university development was more relevant to the mission of NSF than to DOD.

The table below shows that Project THEMIS funds were more heavily concentrated in geographical areas which received smaller shares of DOD R&D funds and Federal R&D funds during the 1967-70 period. Eighty-two percent of the recipient institutions ranked 50th or lower in Federal R&D funds in 1967. Only 1 recipient institution ranked in the top 20 in Federal R&D funds.

APPENDIX II

Region	THEMIS funds (1967-70)	DOD R&D funds (1967-70)	Federal R&D funds (1967-70)
	(percent of distribution)		
South Atlantic	19.0	10.4	11.6
West North Central	16.9	3.8	6.3
Middle Atlantic	14.6	15.5	18.4
West South Central	12.5	5.1	6.0
Mountain	9.4	6.5	4.9
East South Central	9.2	1.5	3.2
East North Central	7.1	17.3	17.0
Pacific	6.6	18.0	18.2
New England	4.7	21.9	14.1
Total	100.0	100.0	[a]99.7

[a]Territories outside the United States account for small fraction of total.

UNIVERSITIES MAKING CONSIDERABLE PROGRESS COMPETING FOR FEDERAL RESEARCH AND DEVELOPMENT FUNDS

During the 1964-74 period, many institutions made considerable progress in competing for Federal R&D funds. Twenty universities experienced more than 200 percent growth in Federal R&D funds received, and 18 universities gained by 150 to 200 percent. During the same period total Federal R&D funds to universities increased by about 127 percent.

We visited four universities that had more than a 200-percent increase in Federal R&D funds and met with administrators and researchers to discuss the factors accounting for the universities' progress.

UNIVERSITY OF CALIFORNIA AT SAN DIEGO

The University of California at San Diego (UCSD), one of nine campuses in the University of California system, consists of the General Campus (four colleges), the School of Medicine, and the Scripps Institution of Oceanography (SIO). It was established in the late 1950s with SIO forming its nucleus. At first only graduate studies in the physical and natural sciences were offered. UCSD did not accept its first undergraduates until 1964. SIO was originally an independent research laboratory, dating back to 1903, which became an integral part of the University of California in 1912. The School of Medicine accepted its first undergraduates in 1968. A teaching hospital is located in downtown San Diego about 15 miles away from the General Campus. In 1974 UCSD received an $11.8 million Federal grant for construction at the medical school.

UCSD has 9,259 students: 7,596 undergraduates, 1,344 graduate students (including 190 at SIO), and 319 students in the School of Medicine. Plans call for UCSD to increase to about 12,000 students during the 1980s.

Funding sources

During fiscal year 1974, UCSD's receipts totaled $146.4 million. Major fund sources were the Federal Government, $59.9 million (40.9%); the State of California, $36.2 million (24.7%); and the University Hospital, $24.6 million (16.8%). The greatest single expenditure, $52.9 million was for organized research which represented 39 percent of total expenditures. The next largest amount, $27.6 million was for the University Hospital.

During fiscal year 1975, UCSD received $72.8 million in awards from Federal and non-Federal sources for research and training activities. Federal agencies providing most of the funds were NSF, $25 million, and HEW, $22 million. These awards went to the three components of UCSD as follows:

	Amount (millions)	Percent
SIO	$33	45
School of Medicine	23	32
General Campus	17	23
Total	$73	100

Federal science funds

Federal R&D funds to UCSD have increased from $7.1 million in 1964 to $53.3 million in 1974, an increase of 642 percent. In 1974 UCSD ranked 5th in Federal R&D to universities, compared to 37th in 1964. In 1974 UCSD received an $11.5 million grant from NSF for the Deep Sea Drilling project, which accounted for part of the growth.

During the 1960s and early 1970s, UCSD received awards under several Federal science programs amounting to over $2 million.

Departmental Science Development (NSF)	$ 571,000
Project THEMIS (DOD)	823,000
Sustaining University Program (National Aeronautics and Space Administration) (note a)	615,000
Total	$2,009,000

[a]This program was initiated in 1961, 4 years before the Presidential message of 1965, and was terminated in 1971.

Factors accounting for growth in R&D

According to UCSD administrators and researchers, the main factors accounting for the growth in Federal R&D are the quality of the university and its outstanding researchers. They believe that the university became a first-rate institution by attracting top scientists who, in turn, were able to attract large research awards and other quality researchers. UCSD has three Nobel Prize Laureates, 46 National Academy of Sciences fellows, and 43 American Academy of Arts and Sciences fellows.

UCSD attributes its success in recruiting top research talent to its being a young and growing institution with strong administrative leadership and a commitment to excellence in research. Several faculty members cited the intellectually exciting atmosphere as one of UCSD's attractive features. There is an open intellectual environment with a great deal of interaction among departments. For example, the medical school is integrated with the basic sciences on the General Campus, and some professors serve in both areas.

UCSD emphasizes the importance of research to its faculty members. A faculty member's research is a major factor in the tenure decision and serves as a criterion for the advancement of tenured faculty.

UNIVERSITY OF ALABAMA AT BIRMINGHAM

The University of Alabama at Birmingham (UAB) became one of three independent campuses within the University of Alabama system in 1969, growing out of a University of Alabama extension center established in 1936 and a medical school which opened in 1945. Principal units of UAB are the Medical Center, the University College (undergraduate unit), and the Graduate School.

The financial report for the 1973-74 school year showed that UAB had revenues of $109 million, including $26 million in Federal funds. UAB employs 6,700 people, making it tne largest employer in Birmingham and the second largest in Jefferson County. Student enrollment during the fall of 1974 was estimated at over 10,000: 7,300 undergraduate and paraprofessional students and 3,100 graduate and professional students.

Federal science funds

Federal science funds to UAB have increased from about $3 million in 1964 to $18.4 million in 1974. The R&D component of the Federal science funds has increased from less than $3 million in 1964 to $15.8 million in 1974, over 400 percent. UAB ranked 80th in Federal R&D funds among colleges and universities in 1964. In 1974 UAB ranked 40th.

About 72 percent of the Federal research funds went to the UAB Medical School, where the two primary research areas are cardiovascular disease and cancer. The National Institutes of Health (NIH) has greatly increased its funding of these research areas during the 1967-74 period.

A UAB official told us that, except for NIH General Research Support, UAB was not very successful in getting Federal institutional support funds. For example, UAB applied for, but was not able to get, funds under Project THEMIS, DOD; Sustaining University Program, National Aeronautics and Space Administration; Health Sciences Advancement Awards, NIH; and the Science Development Program, NSF. UAB did, however, receive some funds under NSF's College Science Improvement Program through consortium arrangements.

Factors accounting for growth in R&D

UAB officials told us that the growth of UAB could not be attributed to one particular factor and that it was a matter of timing which was in UAB's favor. They said that:

--UAB administration had created an environment which encouraged research along with teaching.

--UAB had attracted outstanding research faculty members with national reputations in their fields, who attracted research funds.

--UAB had implemented the principle of academic freedom allowing the faculty to decide their research interests.

--UAB had developed strong research capability in the national priority research areas of cancer and cardiovascular disease.

--UAB had recently established 12 endowed faculty chairs to aid in recruiting outstanding scientists and scholars.

--Local community support from business and civic interests helped in providing construction funds when State funds were not available.

COLORADO STATE UNIVERSITY

The Colorado State University (CSU), established in 1870 as the Agricultural College of Colorado, became a State institution in 1876 and received its present name in 1957.

CSU has three campuses located in or near the city of Fort Collins. The main campus is located within the

city. The Foothills and Pingree Park campuses are used for educational and research programs in forestry, engineering, and biological sciences. CSU also operates 11 research centers Statewide.

CSU grew slowly until the end of World War II; registration for the 1945 fall term was 1,037. During the 1950s and 1960s, student enrollment increased sharply and reached 6,131 by 1960 and 17,045 by 1970. To accommodate this growth, the main campus expanded to more than 100 buildings, and the Foothills campus was established. Recently completed science facilities are a chemistry building, an anatomy-zoology building, and a microbiology building. Buildings for forestry and natural resources, home economics, and pathology are being constructed.

Federal science funds

Federal R&D funds to CSU increased from $3.7 million in 1964 to $13.5 million in 1974, a growth of 265 percent. In 1974 CSU ranked 45th in Federal R&D funds, compared to 68th in 1964. In 1974 major Federal R&D funds came from NSF, 34.8 percent; HEW, 22.7 percent; the Department of Agriculture, 10.7 percent; and the Environmental Protection Agency, 7.4 percent.

During the 1960s and early 1970s, CSU received awards of $3.9 million under several Federal science programs.

Departmental Science Development (NSF)	$ 600,000
College Science Improvement Program (NSF)	133,700
Project THEMIS (DOD)	2,340,000
Sustaining University Program, (National Aeronautics and Space Administration)	836,900
Total	$ 3,910,600

Factors accounting for growth in R&D

CSU administrators and researchers pointed out several factors accounting for CSU's growth in R&D.

--The administration is dedicated to research. The faculty feels no limitation from the school when pursuing research efforts. The administration is willing to gamble on hiring young researchers.

--CSU hired some top quality researchers in a few areas, which enabled CSU to have a national impact in these areas.

--Some CSU researchers were able to obtain funds in areas of Federal Government interest. Many projects are weighted toward applied research.

--Federal institutional development grants enabled the recipient departments to build up their research capabilities.

--In one college, a major effort was made to replace faculty members who had discouraged research with persons dedicated to excellence in research and education.

--Most CSU researchers are relatively young, and barriers between departments are low and therefore makes it easier to develop interdisciplinary research.

BOSTON UNIVERSITY

Boston University, established in 1869, has become a large, independent, private university. It offers programs to its students in about 130 areas of concentration in 16 different schools and colleges. The largest school is the College of Liberal Arts.

The university's undergraduate schools and colleges are located at the Charles River campus near the center of Boston. The University's Medical Center, located in the south end of the city, contains the Schools of Medicine and Graduate Dentistry and the University Hospital.

The university recently proposed a $12.6 million revenue bond issue to construct additions to the Schools of Medicine and Graduate Dentistry and to other buildings. Since 1939 the university has completed $100 million in construction projects. Another $100 million building project is about to be completed at the Medical Center.

A university official said that the university has had three different administrations over the last 10 years. Since 1970 its present administration has tried to build a strong research program. Enrollment (graduates and undergraduates) during the fall of 1973 consisted of 17,000 full-time and 6,000 part-time students. Teaching and research

activities are conducted by 1,200 full-time faculty members, two-thirds of whom hold doctorates. There are over 1,000 part-time personnel and about 1,800 support personnel. During fiscal year 1975 the university received awards amounting to almost $30 million from Federal and non-Federal sources. The university Medical Center received about $17 million, or 57 percent.

Federal science funds

Federal science funds to the university have increased from $6.5 million in 1964 to $16.7 million in 1974, a 155-percent increase. R&D funds to the university have increased 322 percent, from $2.9 million in 1964 to $12.4 million in 1974. In 1974 the university ranked 50th in Federal R&D funds, compared to 83d in 1964.

A university official told us that NIH General Research Support and the Science Development Program, especially the Departmental Science Development Program, were a great help to the university. The university also received some funds from the National Aeronautics and Space Administration's Sustaining University Program.

Factors accounting for growth in R&D

University officials cited these factors as contributing to the university's growth.

--Its president's outstanding leadership.

--Freedom of faculty to do research.

--Competent research faculty to attract funds.

--Location of the university in a prestigious area.

--The Grant and Contracts Office which assists faculty in proposal preparation and in finding sources of funds for projects.